

MLLNVLRICI	IVCLVNDGAG	KHSEGRERTK	TYSLNSRGYF	40
RKERGARRSK	ILLVNTKGLD	EPHIGHGDFG	LVAELFDSTR	80
THTNRKEPDM	NKVKLFSTVA	HGNKSARRKA	<u>YNGSRRNIFS</u>	120
RRSFDKRNTE	VTEKPGAKMF	WNNFLVKMNG	APQNT <u>SHGSK</u>	160
AQEIMKEACK	TLPFTQNIVH	ENCDRMVIQN	NLCFGKCISL	200
HVPNQDRRN	TCSHCLPSKF	TLNHLTLNCT	GSKNVVKVVM	240
MVEECTCEAH	KSNFHQTAQF	NMDTSTTLHH		270

Figure 1. Deduced amino acid sequence of *Xenopus cerberus* protein. SEQ ID NO:1.

Figure 2. Nucleotide sequence of the full-length cerberus DNA derived from the *Xenopus* organizer. The sense strand is on top (in the 5' to 3' direction) and the antisense strand on the bottom line (on the opposite direction). SEQ ID NO:2.

GAATTC	CCAG	CAAGTCGCTC	AGAAACACTG	CAGGGTCTAG	ATATCATACA	ATGTTACTAA	60
CTTAAG	GGGTC	GTTCCAGCGAG	TCTTTGTGAC	GTCCAGATC	TATAGTATGT	TACAATGATT	
ATGTACTCAG	GATCTGTATT	ATCGTCTGCC	TTGTGAATGA	TGGAGCAGGA	AAACACTCAG	120	
TACATGAGTC	CTAGACATAA	TAGCAGACGG	AACACTTACT	ACCTCGTCCT	TTTGTGAGTC		
AAGGACGAGA	AAGGACAAAA	ACATATTAC	TTAACAGCAG	AGGTTACTTC	AGAAAAGAAA	180	
TTCTGCTCT	TTCTGTTTT	TGTATAAGTG	AATTGTCGTC	TCCAATGAAG	TCTTTTCTTT		
GAGGAGCAGC	TAGGAGCAAG	ATTCTGCTGG	TGAATACTAA	AGGTCTTGAT	GAACCCACA	240	
CTCCTCGTGC	ATCCTCGTTC	TAAGACGACC	ACTTATGATT	TCCAGAACTA	CTTGGGGTGT		
TTGGGCATGG	TGATTTTCGC	TTAGTAGCTG	AACTATTTGA	TTCCACCAGA	ACACATACAA	300	
AACCCGTACC	ACTAAAAGCG	AATCATCGAC	TTGATAAACT	AAGGTGGTCT	TGTGTATGTT		
ACAGAAAAGA	GCCAGACATG	AACAAAGTCA	AGCTTTTCTC	AACAGTTGCC	CATGGAAACA	360	
TGTCCTTTCT	CGGTCTGTAC	TTGTTTCAGT	TCGAAAAGAG	TTGTCAACGG	GTACCTTTGT		
AAAGTGCAAG	AAGAAAAGCT	TACAATGGTT	CTAGAAGGAA	TATTTTTCCT	CGCCGTTCTT	420	
TTTCACGTTT	TTCTTTTCGA	ATGTTACCAA	GATCTTCCTT	ATAAAAAGGA	GCGGCAAGAA		
TTGATAAAAG	AAATACAGAG	GTTACTGAAA	AGCCTGGTGC	CAAGATGTTT	TGGAACAATT	480	
AACTATTTTC	TTTATGTCTC	CAATGACTTT	TCGGACCACG	GTTCTACAAG	ACCTTGTTAA		
TTTTGGTTAA	AATGAATGGA	GCCCCACAGA	ATACAAGCCA	TGGCAGTAAA	GCACAGGAAA	540	
AAAACCAATT	TTACTTACCT	CGGGGTGTCT	TATGTTTCGGT	ACCGTCATTT	CGTGTCTTTT		
TAATGAAAGA	AGCTTGCAAA	ACCTTGTTTT	TCCTCAGAA	TATTGTACAT	GAAAACGTG	600	
ATTACTTTCT	TCGAACGTTT	TGGAACAAAA	AGTGAGTCTT	ATAACATGTA	CTTTTGACAC		
ACAGGATGGT	GATACAGAAC	AATCTGTGCT	TTGGTAAATG	CATCTCTCTC	CATGTTCCAA	660	
TGTCCTACCA	CTATGTCTTG	TTAGACACGA	AACCATTTAC	GTAGAGAGAG	GTACAAGGTT		
ATCAGCAAGA	TCGACGAAAT	ACTTGTTCCT	ATTGCTTGCC	GTCCAAATTT	ACCCTGAACC	720	
TAGTCGTTCT	AGCTGCTTTA	TGAACAAGGG	TAACGAACGG	CAGGTTTAAA	TGGGACTTGG		
ACCTGACGCT	GAATTGTACT	GGATCTAAGA	ATGTAGTAAA	GGTTGTCATG	ATGGTAGAGG	780	
TGGACTGCGA	CTTAACATGA	CCTAGATTCT	TACATCATTT	CCAACAGTAC	TACCATCTCC		
AATGCACGTG	TGAAGCTCAT	AAGAGCAACT	TCCACCAAAC	TGCACAGTTT	AACATGGATA	840	
TTACGTGCAC	ACTTCGAGTA	TTCTCGTTGA	AGGTGGTTTG	ACGTGTCAAA	TTGTACCTAT		
CATCTACTAC	CCTGCACCAT	TAAAGGACTG	CCATACAGTA	TGGAAATGCC	CTTTTGTGG	900	
GTAGATGATG	GGACGTGGTA	ATTCCTGAC	GGTATGTCAT	ACCTTTACGG	GAAAACAACC		
AATATTTGTT	ACATACTATG	CATCTAAAGC	ATTATGTTGC	CTTCTATTTT	ATATAACCAC	960	
TTATAAACAA	TGTATGATAC	GTAGATTTTC	TAATACAACG	GAAGATAAAG	TATATTGGTG		
ATGGAATAAG	GATTGTATGA	ATTATAATTA	ACAAATGGCA	TTTTGTGTAA	CATGCAAGAT	1020	
TACCTTATTC	CTAACATACT	TAATATTAAT	TGTTTACCGT	AAAACACATT	GTACGTTCTA		

CTCTGTTCCA	TCAGTTGCAA	GATAAAAGGC	AATATTTGTT	TGACTTTTTT	TCTACAAAAT	1080
GAGACAAGGT	AGTCAACGTT	CTATTTTCCG	TTATAAACAA	ACTGAAAAAA	AGATGTTTTA	
GAATACCCAA	ATATATGATA	AGATAATGGG	GTCAAAACTG	TTAAGGGGTA	ATGTAATAAT	1140
CTTATGGGTT	TATATACTAT	TCTATTACCC	CAGTTTTGAC	AATTCCCCAT	TACATTATTA	
AGGGACTAAG	TTTGCCCGAG	AGCAGTGACC	CATAACAACC	AATCAGCAGG	TATGATTTAC	1200
TCCCTGATTG	AAACGGGTCC	TCGTCACTGG	GTATTGTTGG	TTAGTCGTCC	ATACTAAATG	
TGGTCACCTG	TTTAAAAGCA	AACATCTTAT	TGGTTGCTAT	GGGTACTGTC	TTCTGGGCAA	1260
ACCAGTGGAC	AAATTTTCGT	TTGTAGAATA	ACCAACGATA	CCCAATGACG	AAGACCCGTT	
AATGTGTGCC	TCATAGGGGG	GTTAGTGTGT	TGTGTACTGA	ATAAATTGTA	TTTATTTTCA	1320
TTACACACGG	AGTATCCCCC	CAATCACACA	ACACATGACT	TATTTAACAT	AAATAAAGTA	
TGTTACAAAA	AAAAAAA					
ACAATGTTTT	TTTTTTTT					

Fig. 2. (Continuation page 2, SEQ ID NO:2).

1080  
1140  
1200  
1260  
1320

MSRTRKVDSL	LLLAIPGLAL	LLLPNAYCAS	CEPVRIPMCK	SMPWNMTKMP	NHLHHSTQAN	60
AILAIEQFEG	LLTTECSQDL	LFFLCAMYAP	ICTIDFQHEP	IKPCKSV CER	ARAGCEPILI	120
KYRHTWPESL	ACEELPVYDR	GVCISPEAIV	TVEQGTDSMP	DFSMDSNNGN	CGSGREHCKC	180
KPMKATQKTY	LKNYNYVIR	AKVKEVKVVC	HDATAIVEVK	EILKSSLVNI	PKDTVTLTYN	240
SGCLCPQLVA	NEEYIIMGYE	DKERTRLLLV	EGSLAEKWRD	RLAKKVVRWD	QKLRRPRKSK	300
DPVAPIPNKN	SNSRQARS					

Figure 3. Deduced amino acid sequence of *Xenopus* frazzled protein. SEQ ID NO:3.





MLLLFRAIPM LLLGLMVLQT DCEIAQYYID EEEPPGTVIA VLSQHSIFNT TDIPATNFRL	60
MKQFNNSLIG VRES DGQLSI MERIDREQIC RQSLHCNLAL DVVSFSKGF KLLNVKVEVR	120
DINDHSPHFP SEIMHVEVSE SSSVGTRIPL EIAIDEDVGS NSIQNFQISN NSHFSIDVLT	180
RADGVKYADL VLMRELDREI QPTYIMELLA MDGGVPSLSG TAVVNIRVLD FNDNSPVFER	240
STIAVDLVED APLGYLLEL HATDDDEGVN GEIVYGFSTL ASQEVRLFK INSRTGSVTL	300
EGQVDFETKQ TYEFEVQAQD LGPNPLTATC KVTVHILDVN DNTPAITITP LTTVNAGVAY	360
IPETATKENF IALISTTDRA SGSNGQVRCT LYGHEHFKLQ QAYEDSYMIV TTSTLDRENI	420
AAYSLTVVAE DLGFPSLGTK KYITVKVSDE NDNAPVFSKP QYEASILENN APGSYITTVI	480
ARDSDSQNG KVNRYRLVDAK VMGQSLTTFV SLDADSGVLR AVRSLDYEKL KQLDFEIEAA	540
DNGIPQLSTR VQLNLRIVDQ NDNCPVITNP LLNNGSGEVL LPISAPQNYL VFQLKAEDSD	600
EGHNSQLFYT ILRDPSRLFA INKESGEVFL KKQLNSDHSE DLSIVVAVYD LGRPSLSTNA	660
TVKFILTDSF PSNVEVILQ PSAEEQHQID MSIIFIAVLA GGCALLLLAI FFVACTCKKK	720
AGEFKQVPEQ HGTCNEERLL STPSQSVSS SLSQSESCQL SINTESENCV VSSNQEQHQQ	780
TGIKHSISVP SYHTSGWHLN NCAMSGHGS HMGHISTKVQ WAKEIVTSMT VTLILVENQK	840
RRALSSQCRH KPVLTNTQMNQ QGSDMPITIS ATESTRVQKM GTAHCMNKRA IDCLTL	

Figure 5. Deduced amino acid sequence of the *Xenopus* PAPC (paraxial protocadherin) protein. It encodes a member of the cadherin family of transmembrane proteins that has dorsalizing activity when constructs are injected into *Xenopus* embryos. SEQ ID NO:5.

Figure 6. Nucleotide sequence of the full-length PAPC cDNA derived from the *Xenopus* organizer. The sense strand of the DNA is shown in the top line (in the 5' to 3' direction), and the bottom line shows the antisense strand (opposite orientation). SEQ ID NO:6.

GAATTC	CCAG	AGATGA	ACTC	CTTGAG	ATTG	TTTTAA	TGA	CTGCAG	GTCT	GGAAGG	ATTC	60
CTTAAG	GGTC	TCTACT	TGAG	GAAC	TCTAAC	AAAATT	TACT	GACGTC	CAGA	CCTTC	CTAAG	
ACATTG	CCAC	ACTGTT	TCTA	GGCATG	AAAA	AACTGC	AAGT	TTCAAC	TTTG	TTTTGG	TGC	120
TGTAAC	GGTG	TGACAA	AGAT	CCGTACT	TTTT	TTGACG	TTCA	AAGTTG	AAAC	AAAAAC	CACG	
AACTTT	GATT	CTTCAAG	ATG	CTGCTT	CTCT	TCAGAG	CCAT	TCCAAT	GC	CTGT	TGGG	180
TTGAA	ACTAA	GAAGTT	CTAC	GACGA	AAGA	AGTCTC	GGTA	AGGTTA	CGAC	GACAAC	CCCTG	
TGATGG	TTTT	ACAAAC	GAGAC	TGTGAA	AATTG	CCCAGT	ACTA	CATAGAT	GAA	GAAGA	ACCCC	240
ACTAC	CAAAA	TGTTTG	TCTG	ACACTT	TAAAC	GGGTCAT	GAT	GTATCT	ACTT	CTTCTT	TGGGG	
CTGGCA	CTGT	AATTGC	AGTG	TTGTC	CACAAC	ACTCCAT	ATT	TAACACT	TACA	GATATA	CCCTG	300
GACCGT	GACA	TTAACG	TCAC	AACAGT	GTG	TGAGGT	TATAA	ATTGTG	ATGT	CTATAT	TGGAC	
CAACCA	AATTT	CCGTCT	AATG	AAGCA	AATTTA	ATAATT	CCCT	TATCGG	AGTC	CGTGAG	AGTG	360
GTTGGT	TAAA	GGCAG	ATTAC	TTCGTT	AAAT	TATTA	AGGGA	ATAGCC	TCAG	GCACTC	TCAC	
ATGGGC	CAGCT	GAGCAT	CATG	GAGAGG	ATTG	ACCGGG	AGCA	AATCTG	CAGG	CAGTCC	CTTC	420
TACCCG	TCGA	CTCGTA	GTAC	CTCTC	CTAAC	TGGCC	CTCGT	TTAGAC	GTCC	GTCAGG	GAAG	
ACTGCA	ACCT	GGCTTT	TGGAT	TGGTC	AGCT	TTTCCA	AAAG	ACACTT	CAAG	CTTCTG	AACG	480
TGACGT	TGGA	CCGAA	ACCTA	CACCAG	TCGA	AAAGG	TTTCC	TGTGA	AGTT	GAAGAC	TTGC	
TGAAAG	TGGA	GGTGAG	AGAC	ATTAAT	AGAC	ATAGCC	CTCA	CTTTCC	CAGT	GAAATA	ATGC	540
ACTTTC	ACCT	CCACTC	TCTG	TAATT	ACTG	TATCGG	GAGT	GAAAGG	GTCA	CTTTAT	TACG	
ATGTGG	AGGT	GTCTGA	AAAGT	TCCTCT	GTGG	GCACC	AGGAT	TCCTTT	AGAA	ATTGCA	ATAG	600
TACAC	CTCA	CAGACT	TTTCA	AGGAG	ACACC	CGTGGT	CTCA	AGGAA	ATCTT	TAACGT	TATC	
ATGAAG	ATGT	TGGGT	CCAAC	TCCAT	CCAGA	ACTTTC	AGAT	CTCAA	ATAAT	AGCCAC	TTCA	660
TACTT	CTACA	ACCCAG	GTG	AGGTAG	GTCT	TGAAAG	TCTA	GAGTTT	TATTA	TCGGT	GAAGT	
GCATTG	ATGT	GCTAAC	CAGA	GCAGAT	TGGG	TGAAAT	ATGC	AGATTT	AGTC	TTAATG	AGAG	720
CGTAA	CTACA	CGATTG	GTCT	CGTCT	ACCCC	ACTTTA	TACG	TCTAA	ATCAG	AATTAC	TCTC	
AACTGG	ACAG	GGAAAT	CCAG	CCAAC	ATACA	TAATGG	AGCT	ACTAG	CAATG	GATGGG	GGTG	780
TTGAC	CTGTC	CCTTTA	GGTC	GGTTGT	ATGT	ATTAC	CTCGA	TGATC	GTTAC	CTACCC	CCAC	
TACCAT	CACT	ATCTGG	TACT	GCAGT	GGTTA	ACATCC	GAGT	CCTGG	ACTTT	AATGAT	AACA	840
ATGGT	AGTGA	TAGACC	ATGA	CGTCA	CCAAT	TGTAGG	CTCA	GGACCT	GAAA	TTACT	ATTGT	
GCCCAG	TGTT	TGAGAG	AAGC	ACCATT	TGCTG	TGGAC	CTAGT	AGAGG	ATGCT	CCTCTG	GGAT	900
CGGGT	CACAA	ACTCT	CTTCG	TGGTA	ACGAC	ACCTGG	ATCA	TCTC	CTACG	GGAGAC	CCTA	
ACCTTT	TGTT	GGAGTT	ACAT	GCTACT	GACG	ATGATG	AAAG	AGTGA	ATGGA	GAAATT	GT	960
TGGAAA	ACAA	CCTCA	ATGTA	CGATG	ACTGC	TACTAC	TTCC	TCAC	TTACCT	CTTTAA	CAAA	
ATGGAT	TCAG	CACTTT	GGCA	TCTCA	AGAG	TACGTC	AGT	ATTTAA	AAAT	AACTCC	AGAA	1020
TACCTA	AGTC	GTGAA	ACCGT	AGAGT	TCTCC	ATGCAG	TCGA	TAAAT	TTTAA	TTGAGG	TCTT	



CTGGCAGTGT TACTCTTGAA GGCCAAGTTG ATTTTGAGAC CAAGCAGACT TACGAATTTG	1080
GACCGTCACA ATGAGAAGCTT CCGGTTCAAC TAAAACTCTG GTTCGTCTGA ATGCTTAAAC	
AGGTACAAGC CCAAGATTTG GGCCCCAACC CACTGACTGC TACTTGTAAG GTAAGTGTTC	1140
TCCATGTTTC GGTTCCTAAC CCGGGGTTGG GTGACTGACG ATGAACATTT CATTGACAAG	
ATATACTTGA TGTAATGAT AATACCCCAG CCATCACTAT TACCCCTCTG ACTACTGTAA	1200
TATATGAACT ACATTTACTA TTATGGGGTC GGTAGTGATA ATGGGGAGAC TGATGACATT	
ATGCAGGAGT TGCCTATATT CCAGAAACAG CCACAAAGGA GAACTTTATA GCTCTGATCA	1260
TACGTCCTCA ACGGATATAA GGTCTTTGTC GGTGTTTCCT CTTGAAATAT CGAGACTAGT	
GCACTACTGA CAGAGCCTCT GGATCTAATG GACAAGTTTC CTGTACTCTT TATGGACATG	1320
CGTGATGACT GTCTCGGAGA CCTAGATTAC CTGTTCAAGC GACATGAGAA ATACCTGTAC	
AGCACTTTAA ACTACAGCAA GCTTATGAGG ACAGTTACAT GATAGTTACC ACCTCTACTT	1380
TCGTGAAATT TGATGTCGTT CGAATACTCC TGTCATGTA CTATCAATGG TGGAGATGAA	
TAGACAGGGA AAACATAGCA GCGTACTCTT TGACAGTAGT TGCAGAAGAC CTTGGCTTCC	1440
ATCTGTCCCT TTTGTATCGT CGCATGAGAA ACTGTCATCA ACGTCTTCTG GAACCGAAGG	
CCTCATTGAA GACCAAAAAG TACTACACAG TCAAGGTTAG TGATGAGAAT GACAATGCAC	1500
GGAGTAACTT CTGGTTTTTC ATGATGTGTC AGTTCCAATC ACTACTCTTA CTGTTACGTG	
CTGTATTTTC TAAACCCCAG TATGAAGCTT CTATTCTGGA AAATAATGCT CCAGGCTCTT	1560
GACATAAAAG ATTTGGGGTC ATACTTCGAA GATAAGACCT TTTATTACGA GGTCCGAGAA	
ATATACTAC AGTGATAGCC AGAGACTCTG ATAGTGATCA AAATGGCAAA GTAAATTACA	1620
TATATTGATG TCACTATCGG TCTCTGAGAC TATCACTAGT TTTACCGTTT CATTTAATGT	
GACTTGTGGA TGCAAAAGTG ATGGGGCAGT CACTAACAAC ATTTGTTTCT CTTGATGCGG	1680
CTGAACACCT ACGTTTTTCAC TACCCGGTCA GTGATTGTTG TAAACAAAGA GAACTACGCC	
ACTCTGGAGT ATTGAGAGCT GTTAGGTCTT TAGACTATGA AAAACTTAAA CAACTGGATT	1740
TGAGACCTCA TAACTCTCGA CAATCCAGAA ATCTGATACT TTTTGAATTT GTTGACCTAA	
TTGAAATTGA AGCTGCAGAC AATGGGATCC CTCAACTCTC CACTCGCGTT CAACTAAATC	1800
AACTTTAACT TCGACGTCTG TTACCCTAGG GAGTTGAGAG GTGAGCGCAA GTTGATTAG	
TCAGAATAGT TGATCAAAAT GATAATTGCC CTGTGATAAC TAATCCTCTT CTTAATAATG	1860
AGTCTTATCA ACTAGTTTTA CTATTAACGG GACACTATTG ATTAGGAGAA GAATTATTAC	
GCTCGGGTGA AGTTCTGCTT CCCATCAGCG CTCCTCAAAA CTATTTAGTT TTCCAGCTCA	1920
CGAGCCCACT TCAAGACGAA GGGTAGTCGC GAGGAGTTTT GATAAATCAA AAGGTCGAGT	
AAGCCGAGGA TTCAGATGAA GGGCACAAC CCCAGCTGTT CTATACCATA CTGAGAGATC	1980
TTGGGCTCCT AAGTCTACTT CCCGTGTTGA GGGTCGACAA GATATGGTAT GACTCTCTAG	
CAAGCAGATT GTTTGCCATT AACAAAGAAA GTGGTGAAGT GTTCCTGAAA AAACAATTAA	2040
GTTCGTCTAA CAAACGGTAA TTGTTTCTTT CACCACTTCA CAAGGACTTT TTTGTTAATT	
ACTCTGACCA TTCAGAGGAC TTGAGCATAG TAGTTGCAGT GTATGACTTG GGAAGACCTT	2100
TGAGACTGGT AAGTCTCCTG AACTCGTATC ATCAACGTCA CATACTGAAC CCTTCTGGAA	
CATTATCCAC CAATGCTACA GTTAAATTCA TCCTCACCGA CTCTTTTCCT TCTAACGTTG	2160
GTAATAGGTG GTTACGATGT CAATTTAAGT AGGAGTGGCT GAGAAAAGGA AGATTGCAAC	

Fig. 6. (Continuation page 2, SEQ ID NO:6).

AAGTCGTTAT	TTTGC AACCA	TCTGCAG AAG	AGCAGCACCA	GATCGATATG	TCCATTATAT	2220
TTACGCAATA	AAACGTTGGT	AGACGTCTTC	TCGTCGTGGT	CTAGCTATAC	AGGTAATATA	
TCATTGCAGT	GCTGGCTGGT	GGTGTGCTT	TGCTACTTTT	GGCCATCTTT	TTTGTGGCCT	2280
AGTAACGTCA	CGACCGACCA	CCAACACGAA	ACGATGAAAA	CCGGTAGAAA	AAACACCGGA	
GTA CTTGTA	AAAGAAAGCT	GGTGAATTTA	AGCAGGTACC	TGAACAACAC	GGAACATGCA	2340
CATGAACATT	TTTCTTTTCGA	CCACTTAAAT	TCGTCCATGG	ACTTGTTTGTG	CCTTGTACGT	
ATGAAGAACG	CCTGTTAAGC	ACCCCATCTC	CCCAGTCGGT	CTCTTCTTCT	TTGTCTCAGT	2400
TACTTCTTGC	GGACAATTTCG	TGGGGTAGAG	GGGTCAGCCA	GAGAAGAAGA	AACAGAGTCA	
CTGAGTCATG	CCA ACTCTCC	ATCAATACTG	AATCTGAGAA	TTGCAGCGTG	TCCTCTAACC	2460
GACTCAGTAC	GGTTGAGAGG	TAGTTATGAC	TTAGACTCTT	AACGTCGCAC	AGGAGATTGG	
AAGAGCAGCA	TCAGCAAACA	GGCATAAAGC	ACTCCATCTC	TGTACCATCT	TATCACACAT	2520
TTCTCGTCGT	AGTCGTTTGT	CCGTATTTCG	TGAGGTAGAG	ACATGGTAGA	ATAGTGTGTA	
CTGGTTGGCA	CCTGGACAAT	TGTGCAATGA	GCATAAGTGG	ACATTCTCAC	ATGGGGCACA	2580
GACCAACCGT	GGACCTGTTA	ACACGTTACT	CGTATTCAAC	TGTAAGAGTG	TACCCCGTGT	
TTAGTACAAA	GGTACAGTGG	GCAAAGGAGA	TAGTGACTTC	AATGACAGTG	ACTCTGATAC	2640
AATCATGTTT	CCATGTCACC	CGTTTCTCT	ATCACTGAAG	TTACTGTCTAC	TGAGACTATG	
TAGTGGAGAA	TCAGAAAAGA	AGAGCATTGA	GCAGCCAATG	CAGGCACAAG	CCAGTGCTCA	2700
ATCACCTCTT	AGTCTTTTCT	TCTCGTAACT	CGTCGGTTAC	GTCCGTGTTC	GGTCACGAGT	
ATACACAGAT	GAATCAGCAG	GGTTCGGACA	TGCCGATAAC	TATTTTCAGCC	ACCGAATCAA	2760
TATGTGTCTA	CTTAGTCGTC	CCAAGGCTGT	ACGGCTATTG	ATAAAGTCGG	TGGCTTAGTT	
CAAGGGTCCA	GAAAATGGGA	ACTGCACATT	GCAATATGAA	AAGGGCTATA	GACTGTCTTA	2820
GTTCCAGGT	CTTTTACCCT	TGACGTGTAA	CGTTATACTT	TTCCCGATAT	CTGACAGAAT	
CTCTGTAGCT	CCTGTATATT	ACAATACCTA	CCATGCAAGA	ATGCCTAACC	TGCACATACC	2880
GAGACATCGA	GGACATATAA	TGTTATGGAT	GGTACGTTCT	TACGGATTGG	ACGTGTATGG	
GAACCATACC	CTTAGAGACC	CTTATTACCA	TATCAATAAT	CCTGTTGCTA	ATCGGATGCA	2940
CTTGGTATGG	GAATCTCTGG	GAATAATGGT	ATAGTTATTA	GGACAACGAT	TAGCCTACGT	
GGCGGAATAT	GAAAGAGATT	TAGTCAACAG	AAGTGCAACG	TTATCTCCGC	AGAGATCGTC	3000
CCGCCTTATA	CTTTCTCTAA	ATCAGTTGTC	TTCACGTTGC	AATAGAGGCG	TCTCTAGCAG	
TAGCAGATAC	CAAGAATTCA	ATTACAGTCC	GCAGATATCA	AGACAGCTTC	ATCCTTCAGA	3060
ATCGTCTATG	GTTCTTAAGT	TAATGTCAGG	CGTCTATAGT	TCTGTCTGAAG	TAGGAAGTCT	
AATTGCTACA	ACCTTTTAAT	CATTAGGCAT	GCAAGTGAGA	ATGCACAAAG	GCAAGTGCTT	3120
TTAACGATGT	TGGAAAATTA	GTAATCCGTA	CGTTCACTCT	TACGTGTTTC	CGTTCACGAA	
TAGCATGAAA	GCTAAATATA	TGGAGTCTCC	CCTTTCCCTC	TGATGGATGG	GGGGAGACAC	3180
ATCGTACTTT	CGATTATAT	ACCTCAGAGG	GGAAAGGGAG	ACTACCTACC	CCCCCTCTGTG	
AGGACAGTGC	ATAAATATAC	AGCTGCTTTC	TATTTGCATT	TCACTTGGGA	ATTTTTTGT	3240
TCCTGTCACG	TATTTATATG	TCGACGAAAG	ATAAACGTAA	AGTGAACCT	TAAAAAACAA	
TTTTTTACAT	ATTTATTTTT	CCTGAATTGA	ATGTGACATT	GTCCTGTCAC	CTAACTAGCA	3300
AAAAAATGTA	TAAATAAAAA	GGACTTAACT	TACACTGTAA	CAGGACAGTG	GATTGATCGT	

Fig. 6. (Continuation page 3, SEQ ID NO:6).



MVCCGPGRML LGWAGLLVLA ALCLLQVPGA QAAACEPVRI PLCKSLPWNM TKMPNHLHHS 60  
TQANAILAME QFEGLLGTHC SPDLLFFLCA MYAPICTIDF QHEPIKPCKS VCERARQGCE 120  
PILIKYRHSW PESLACDELP VYDRGVCISP EAIVTADGAD FPMDSSTGHC RGASSERCKC 180  
KPVRATQKTY FRNNYNYVIR AKVKEVKMKC HDVTAVVEVK EILKASLVNI PRDTVNLVTT 240  
SGCLCPPLTV NEEYVIMGYE DEERSRLLLV EGSIAEKWKD RLGKKVKRWD MKLRHLGLGK 300  
TDASDSTQNQ KSGRNSNPRP ARS.

Figure 7. Deduced amino acid sequence of mouse FRZB-1 protein. SEQ ID NO:7.

Figure 8. Nucleotide sequence of the full-length mouse FRZB-1 cDNA. SEQ ID NO:8.

AAGCCTGGGA	CCATGGTCTG	CTGCGGCCCCG	GGACGGATGC	TGCTAGGATG	GGCCGGGTTG	60
TTCGGACCCT	GGTACCAGAC	GACGCCGGGC	CCTGCCTACG	ACGATCCTAC	CCGGCCCAAC	
CTAGTCCTGG	CTGCTCTCTG	CCTGCTCCAG	GTGCCCCGAG	CTCAGGCTGC	AGCCTGTGAG	120
GATCAGGACC	GACGAGAGAC	GGACGAGGTC	CACGGGCCTC	GAGTCCGACG	TCGGACACTC	
CCTGTCCGCA	TCCCCGCTGTG	CAAGTCCCTT	CCCTGGAACA	TGACCAAGAT	GCCCAACCAC	180
GGACAGGCGT	AGGGCGACAC	GTTCAGGGAA	GGGACCTTGT	ACTGGTTCTA	CGGGTTGGTG	
CTGCACCACA	GCACCCAGGC	TAACGCCATC	CTGGCCATGG	AACAGTTCGA	AGGGCTGCTG	240
GACGTGGTGT	CGTGGGTCCG	ATTGCGGTAG	GACCGGTACC	TTGTCAAGCT	TCCCACGAC	
GGCACCCACT	GCAGCCCGGA	TCTTCTCTTC	TTCCTCTGTG	CAATGTACGC	ACCCATTTGC	300
CCGTGGGTGA	CGTCGGGCCT	AGAAGAGAAG	AAGGAGACAC	GTTACATGCG	TGGGTAAACG	
ACCATCGACT	TCCAGCACGA	GCCCATCAAG	CCCTGCAAGT	CTGTGTGTGA	GCGCGCCCGA	360
TGGTAGCTGA	AGGTCGTGCT	CGGGTAGTTC	GGGACGTTCA	GACACACACT	CGCGCGGGCT	
CAGGGCTGCG	AGCCCATTCT	CATCAAGTAC	CGCCACTCGT	GGCCGGAAG	CTTGGCCTGC	420
GTCCCGACGC	TCGGGTAAGA	GTAGTTCATG	GCGGTGAGCA	CCGGCCTTTC	GAACCGGACG	
GACGAGCTGC	CGGTGTACGA	CCGCGGCGTG	TGCATCTCTC	CTGAGGCCAT	CGTCACCGCG	480
CTGCTCGACG	GCCACATGCT	GGCGCCGCAC	ACGTAGAGAG	GACTCCGGTA	GCAGTGGCGC	
GACGGAGCGG	ATTTTCCTAT	GGATTCAAGT	ACTGGACACT	GCAGAGGGGC	AAGCAGCGAA	540
CTGCCTCGCC	TAAAAGGATA	CCTAAGTTCA	TGACCTGTGA	CGTCTCCCCG	TTCGTCGCTT	
CGTTGCAAAT	GTAAGCCTGT	CAGAGCTACA	CAGAAGACCT	ATTTCCGGAA	CAATTACAAC	600
GCAACGTTTA	CATTTCGGACA	GTCTCGATGT	GTCTTCTGGA	TAAAGGCCTT	GTTAATGTTG	
TATGTCATCC	GGGCTAAAGT	TAAAGAGGTA	AAGATGAAAT	GTCATGATGT	GACCGCCGTT	660
ATACAGTAGG	CCCGATTTC	ATTTCTCCAT	TTCTACTTTA	CAGTACTACA	CTGGCGGCAA	
GTGGAAGTGA	AGGAAATTCT	AAAGGCATCA	CTGGTAAACA	TTCCAAGGGA	CACCGTCAAT	720
CACCTTCACT	TCCTTTAAGA	TTTCCGTAGT	GACCATTGT	AAGGTTCCCT	GTGGCAGTTA	
CTTTATACCA	CCTCTGGCTG	CCTCTGTCCT	CCACTTACTG	TCAATGAGGA	ATATGTCATC	780
GAAATATGGT	GGAGACCGAC	GGAGACAGGA	GGTGAATGAC	AGTTACTCCT	TATACAGTAG	
ATGGGCTATG	AAGACGAGGA	ACGTTCCAGG	TTACTCTTGG	TAGAAGGCTC	TATAGCTGAG	840
TACCCGATAC	TTCTGCTCCT	TGCAAGGTCC	AATGAGAACC	ATCTTCCGAG	ATATCGACTC	
AAGTGGAAGG	ATCGGCTTGG	TAAGAAAGTC	AAGCGCTGGG	ATATGAAACT	CCGACACCTT	900
TTCACCTTCC	TAGCCGAACC	ATTCTTTTCAG	TTCGCGACCC	TATACTTTGA	GGCTGTGGAA	
GGACTGGGTA	AAACTGATGC	TAGCGATTCC	ACTCAGAATC	AGAAGTCTGG	CAGGAACCTC	960
CCTGACCCAT	TTTGACTACG	ATCGCTAAGG	TGAGTCTTAG	TCTTCAGACC	GTCTTGTAGA	









**Figure 10.** Nucleotide sequence of the full-length human FRZB-1 cDNA. SEQ ID NO:10.  
This sequence was assembled from public ESTs from the Genbank database  
(accession numbers: H18848, R63748, W38677, W44760, H38379 and N71244).

GGCGGAGCGG GCCTTTTGGC GTCCACTGCG CGGCTGCACC CTGCCCCATC TGCCGGGATC	60
CCGCCTCGCC CGGAAAACCG CAGGTGACGC GCCGACGTGG GACGGGGTAG ACGGCCCTAG	
ATGGTCTGCG GCAGCCCGGG AGGGATGCTG CTGCTGCGGG CCGGGCTGCT TGCCCTGGCT	120
TACCAGACGC CGTCGGGCCC TCCCTACGAC GACGACGCC GGCCCGACGA ACGGGACCGA	
GCTCTCTGCC TGCTCCGGGT GCCCGGGGCT CGGGCTGCAG CCTGTGAGCC CGTCCGCATC	180
CGAGAGACGG ACGAGGCCCA CGGGCCCCGA GCCCGACGTC GGACACTCGG GCAGGCGTAG	
CCCCTGTGCA AGTCCCTGCC CTGGAACATG ACTAAGATGC CCAACCACCT GCACCACAGC	240
GGGGACACGT TCAGGGACGG GACCTTGTA TGATTCTACG GGTGGGTGGA CGTGGTGTCTG	
ACTCAGGCCA ACGCCATCCT GGCCATCGAG CAGTTCGAAG GTCTGCTGGG CACCCACTGC	300
TGAGTCCGGT TGCGGTAGGA CCGGTAGCTC GTCAAGCTTC CAGACGACCC GTGGGTGACG	
AGCCCCGATC TGCTCTTCTT CCTCTGTGCC ATGTACGCGC CCATCTGCAC CATTGACTTC	360
TCGGGGCTAG ACGAGAAGAA GGAGACACGG TACATGCGCG GGTAGACGTG GTAAGTGAAG	
CAGCACGAGC CCATCAAGCC CTGTAAAGTCT GTGTGCGAGC GGGCCCCGCA GGGCTGTGAG	420
GTCGTGCTCG GGTAGTTCGG GACATTTCAGA CACACGCTCG CCCGGGCCGT CCCGACACTC	
CCCATACTCA TCAAGTACCG CCACTCGTGG CCGGAGAACC TGGCCTGCGA GGAGCTGCCA	480
GGGTATGAGT AGTTCATGGC GGTGAGCACC GGCCTCTTGG ACCGGACGCT CCTCGACGGT	
GTGTACGACA GGGGCGTGTG CATCTCTCCC GAGGCCATCG TTAAGTGCAG CGGAGCTGAT	540
CACATGCTGT CCCCACAC GTAGAGAGGG CTCCGGTAGC AATGACGCCT GCCTCGACTA	
TTTCCTATGG ATTCTAGTAA CGGAAACTGT AGAGGGGCAA GCAGTGAACG CTGTAAATGT	600
AAAGGATACC TAAGATCATT GCCTTTGACA TCTCCCCGTT CGTCACTTGC GACATTTACA	
AAGCCTATTA GAGCTACACA GAAGACCTAT TTCCGGAACA ATTACAATA TGTCATTCCG	660
TTCGGATAAT CTCGATGTGT CTTCTGGATA AAGGCCTTGT TAATGTTGAT ACAGTAAGCC	
GCTAAAGTTA AAGAGATAAA GACTAAGTGC CATGATGTGA CTGCAGTAGT GGAGGTGAAG	720
CGATTTCAAT TTCTCTATTT CTGATTCACG GTACTACACT GACGTCATCA CCTCCACTTC	
GAGATTCTAA AGTCCTCTCT GGTAAACATT CCACGGGACA CTGTCAACCT CTATACCAGC	780
CTCTAAGATT TCAGGAGAGA CCATTTGTAA GGTGCCCTGT GACAGTTGGA GATATGGTCG	
TCTGGCTGCC TCTGCCCTCC ACTTAATGTT AATGAGGAAT ATATCATCAT GGGCTATGAA	840
AGACCGACGG AGACGGGAGG TGAATTACAA TTAAGCTTCA TATAGTAGTA CCCGATACTT	

